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METHOD FOR MEASURING BULK DENSITY OF IRON OXIDES: LUMP ORES, SINTER AND PELLETS

(First Revision)

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METHOD FOR MEASURING BULK DENSITY OF IRON OXIDES: LUMP ORES, SINTER AND PELLETS

(First Revision)

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AMENDMENT NO. 1 NOVEMBER 1993
TO
IS 5842 : 1986 METHOD FOR MEASURING BULK DENSITY IRON OXIDES : LUMP ORES, SINTER AND PELLETS

(First Revision)

(*Page* 4, *clause* **2.1**) — Add a new sub-clause as follows:

'**2.2 Maximum Particle Size**

The particle size expressed in terms of the aperture of the sieve on which approximately 5 percent (*m/m*) of an Iron Ore/Sinter/Pellet is retained.'

(*Page* 5, *clause* **5.1.1**, *line* 2) — Substitute the word 'precision' *for* 'error'.

(MTD 13)

Reprography Unit, BIS, New Delhi, India

IS : 5842 - 1986
(Superseding IS : 5843)

Indian Standard

METHOD FOR MEASURING BULK DENSITY OF IRON OXIDES: LUMP ORES, SINTER AND PELLETS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 1 December 1986, after the draft finalized by the Ores and Raw Materials Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1970. In this revision the contents of IS : 5843-1970 ' Method for measuring the bulk density of iron ore and iron ore agglomerates including sinters in a large container (applicable for size over 40 mm)' have been suitably merged for the convenience of the user for measuring bulk density of iron ores, pellets and sinter, irrespective of the sizes.

0.3 Knowledge of bulk density of ores and agglomerates is often required during transportation, calculation of masses of stockpiled material *in situ*, designing of plants related to ore handling and in ore dressing.

0.4 The method prescribed in this standard is equally valid for other minerals and may be applied when need arises.

0.5 In the preparation of this revision, assistance has been derived from ISO/DP 3852 'Iron Ores — Method of bulk density test', formulated by the International Organization for Standardization (ISO).

0.6 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes the method for determining the bulk density (in tonnes/m^3) of iron ores (lumps, sized ores, fines, concentrates) and agglomerates including sinter and pellets.

---

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definition shall apply.

2.1 Bulk Density — The mass in air, at a stated temperature of a unit volume of the material in question including the voids within and between particles.

NOTE — Moisture content and size distribution are two main factors which affect bulk density. The moisture content and the size distribution shall be reported alongwith the bulk density value to ensure proper interpretation.

3. SAMPLING

3.1 The sampling of iron oxides : lump ores, sinter and pellets for the purpose of conducting the test shall be as per IS : 1405-1982*, IS : 11607-1986† and IS : 9101-1979‡.

3.2 The sample shall be of sufficient quantity to fill the container, used for the measurement, three times, with a small overflow and also to provide for the determination of size distribution, moisture content and chemical analysis.

3.3 The bulk density test may be carried out on natural air-dried material. If the test is to be made on oven dried material using a small container, the sample shall be dried at 105 ± 5°C.

4. TEST APPARATUS

4.1 Measure for Sample — Any large container such as a truck or a railway wagon of regular geometrical shape with smooth inner surfaces of walls and bottom and in good condition shall be taken. The container shall have sufficient capacity to holds when filled a minimum of 10 tonnes of sample to a minimum height of sample bed of 500 mm.

NOTE — For iron ore lumps, sinter and pellets of sizes less than 40 mm, a cylindrical metal container, having an internal diameter of 400 ± 2 mm and internal height of 400 ± 2 mm (volume : 0·05 m^3) may be used. The container shall be constructed of metal of sufficient thickness to ensure the rigidity of the walls and base of the container under the conditions of the test. The container shall be reinforced by a steel band around the top and shall have four handles, separated by 90°, attached to the outer surface by welding.

4.2 Scales — A weighing apparatus, preferably of the platform type having a capacity commensurate with the masses to be determined and a sensitivity of around 1/100 of full deflection.

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*Methods of sampling iron ore (*first revision*).

†Methods of sampling iron ore sinters.

‡Methods of sampling iron ore pellets.

5. PROCEDURE

5.1 For Large Container

5.1.1 Weigh the empty container. Measure the length, width and height of the container within an error of 0·1 percent and calculate its volume.

5.1.2 With the container on a level surface, carefully discharge the sample into it in such a manner as to minimize breakage. Level the upper surface by sliding a straight edge across the top of the container and removing the pieces which obstruct the passage of the straight edge. In filling the container care should be taken to avoid obvious segregation of lumps and fines.

5.1.3 Reweigh the filled container.

5.1.4 Calculate the bulk density according to the formula given in **7.1**.

5.1.5 Repeat the test using the same or a second container of similar capacity.

5.2 For Small Cylindrical Container

5.2.1 *Loose Mass Determination*

5.2.1.1 The dry container shall be weighed and the mass recorded to the nearest 0·1 kg. Calculate to volume of the container within an error of 0·1 litre.

NOTE — The volume of the container may be calculated by first recording the mass in g of water required to fill the container. The mass of the water so obtained shall be expressed in litres.

5.2.1.2 The container shall be filled to overflowing by means of a shovel or a scoop, the material being discharged from a height not exceeding 50 mm from the surface of the material inside the container. Care shall be taken to prevent obvious segregation of the particle sizes of which the sample is composed. The surface of the sample shall then be levelled off with a straight edge in such a way that any slight projections of the sample above the top edge of the container shall approximately balance the voids in the surface below the top of the container.

5.2.1.3 The filled container shall be transported to the weighing scale without loss of material from the container. The net mass of the sample shall be determined by weighing the filled container to the nearest 0·1 kg and subtracting from this, the mass of the empty container.

5.2.2 *Compact Mass Determination*

5.2.2.1 The container shall be filled in three approximately equal layers. When the mass of the sample permits manual handling each layer shall be compacted by placing the measure on a firm foundation such as a concrete floor and raising alternate sides of the container about 25 mm above the floor and allowing it to drop in such a manner as to hit the floor with sharp, slapping blow. By this procedure, the sample particles will arrange themselves in a closely compacted mass. Each layer shall be compacted by raising and dropping the container 25 times. When the mass of the sample requires mechanical handling this raising and dropping of the container may be done by use of a small crane pulley set up. If a vibrator is to be used, the empty container shall first be firmly attached to the vibrator platform and filled in three approximately equal layers while in this position, each layer being compacted by vibration. The surface of the compacted sample shall then be levelled off with a straight edge as in **5.2.1.2** and weighed as in **5.2.1.3** and the bulk density calculated as in **7.1**.

6. NUMBER OF TESTS

6.1 The test shall be made in duplicate. If the results of the two tests do not meet the permissible tolerance specified in **8**, a third test shall be carried out. If any two results of the three tests meet the tolerance requirement, the respective two values, together with their mean value shall be reported. If any two results do not comply with the tolerance limits, all the three values together with their mean value shall be reported. The mean value shall be reported to the first decimal place.

7. CALCULATION

7.1 The bulk density of the sample, as measured, expressed in tonnes per cubic metre, shall be calculated to the second decimal place by means of the following formula:

$$\text{Bulk density} = \frac{M_1 - M_0}{V}$$

where

M_1 = is the mass, in tonnes, of the container plus the sample (or in kilograms when smaller container is used *see* **5.2**);

M_0 = is the mass, in tonnes, of the empty container (or in kilograms when smaller container is used, *see* **5.2**); and

V = is the volume, in cubic metres of the container (or in litres when smaller container is used *see* **5.2**).

7.2 The final bulk density shall be obtained as indicated in **6**.

PERMISSIBLE TOLERANCE

.1 The results of duplicate determinations carried out by the same perator, with the same apparatus on the samples from the same consign-ıent and taken in succession shall not differ by more than 0·1 tonne/m^3.

.2 The permissible tolerance as specified in **8.1** applies only to samples aken at one point only that is at point of loading or at point of discharge. Io tolerance is stated for samples taken at these two different locations, s transport of the sample involves the risk of size degradation and onsequent variation in bulk density.

. TEST REPORT

.1 The test report shall include the following:

a) Identification of the test sample (that is lumps, fines, concentrate, pellets and sinter);

b) A statement of the condition of the sample as tested. That is natural, air dried (or oven dried);

c) Identification of the measured values whether determined as loose or compact mass;

d) Measured values of all tests and their mean value;

e) Date and method of calibration of the container;

f) Statement of the capacity and sensitivity of the weighing device;

g) Percent moisture content of the sample;

h) Size distribution of the sample showing percent on each sieve;

j) Total iron content of the sample; and

k) Reference of this Indian Standard.

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